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January 2010

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Keywords

design, environmental, dementia, people, care, term, guidelines, long

Disciplines

Arts and Humanities | Life Sciences | Medicine and Health Sciences | Social and Behavioral Sciences

Publication Details

Fleming, R. & Purandare, N. (2010). Long-term care for people with dementia: environmental design guidelines.. *International Psychogeriatrics*, 22 (7), 1084-1096.

REVIEW

Long-term care for people with dementia: environmental design guidelines

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ABSTRACT

Background: A large and growing number of people with dementia are being cared for in long-term care. The empirical literature on the design of environments for people with dementia contains findings that can be helpful in the design of these environments. A schema developed by Marshall in 2001 provides a means of reviewing the literature against a set of recommendations. The aims of this paper are to assess the strength of the evidence for these recommendations and to identify those recommendations that could be used as the basis for guidelines to assist in the design of long term care facilities for people with dementia.

Methods: The literature was searched for articles published after 1980, evaluating an intervention utilizing the physical environment, focused on the care of people with dementia and incorporating a control group, pre-test-post-test, cross sectional or survey design. A total of 156 articles were identified as relevant and subjected to an evaluation of their methodological strength. Of these, 57 articles were identified as being sufficiently strong to be reviewed.

Results: Designers may confidently use unobtrusive safety measures; vary ambience, size and shape of spaces; provide single rooms; maximize visual access; and control levels of stimulation. There is less agreement on the usefulness of signage, homelikeness, provision for engagement in ordinary activities, small size and the provision of outside space.

Conclusions: There is sufficient evidence available to come to a consensus on guiding principles for the design of long term environments for people with dementia.

Key words: literature review, elderly, physical environment, dementia, residential care

Introduction

Globally it is estimated that 24.3 million people have dementia, with 4.6 million new cases of dementia being diagnosed every year. The number of people affected will double every 20 years to 81.1 million by 2040. Most people with dementia live in developing countries (60% in 2001, rising to 71% by 2040) where the design and building of residential services is, at best, embryonic. In these countries, the rate of increase is higher than the average; numbers in developed countries are forecast to increase by 100% between 2001 and 2040, but by more than

300% in India, China, and their South Asian and Western Pacific neighbors (Ferri *et al.*, 2005).

It is estimated that there are 230,000 older people with dementia in Australia (Access Economics, 2009). Of these, 44% were in cared accommodation, mainly residential care but some in health facilities (AIHW, 2007). The proportion of people with dementia who live in households decreases with age – 79% of people with dementia aged 65–74 years still live in the community, but for those aged 85 and over the proportion decreases to 36%. Most people with mild dementia live in households in the community (96%) while most people with moderate or severe dementia are in cared accommodation (91%).

If the Australian figures are applied to the global figures, the result suggests that by 2040 about 36 million people with dementia will require residential care. It may well be that a focus on

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community services or developments in pharmacology will reduce this number but it seems clear that a great many people stand to benefit from well-designed facilities for people with dementia.

In her influential statement on designing environments for people with dementia, Professor Mary Marshall of the Dementia Services Development Centre at the University of Stirling, Scotland, recommended that dementia-specific residential facilities should be designed in a way that compensates for disability, maximizes independence, reinforces personal identity, enhances self esteem/confidence, demonstrates care for staff and welcomes relatives and the local community (Marshall, 2001).

To achieve these results she recommended that residential facilities for people with dementia should:

- be small in size
- control stimuli, especially noise
- enhance visual access, i.e. ensure that the resident can see what they need to see from wherever they spend most of their time
- include unobtrusive safety features
- have rooms for different functions with furniture and fittings familiar to the age and generation of the residents
- have single rooms big enough for a reasonable amount of personal belongings
- be domestic and home-like
- have scope for ordinary activities (unit kitchens, washing lines, garden sheds)
- provide a safe outside space
- provide good signage and multiple cues where possible, e.g. sight, smell, sound
- use objects rather than colour for orientation.

The aims of this paper are to assess the strength of the evidence for these recommendations and to identify those recommendations that could be used as the basis for guidelines to assist in the design of long-term care facilities for people with dementia.

Methods

A report on the empirical evidence available to guide the design of facilities for people with dementia has been conducted for the Primary Dementia Collaborative Research Centre in Australia (Fleming *et al.*, 2008). This paper extends the findings of this report with the inclusion of additional and more recent papers.

The major databases (Medline, Cinahl, PsycInfo, Embase, Central, ProQuest, Pubmed, Google Scholar and Cochrane) were searched electronically and reference lists in earlier reviews, related published articles and books were checked manually.

The search terms were based on those used by Day *et al.* (2000) in their comprehensive review of the literature. These terms were “dementia”, “physical environment”, “home”, “nursing home”, “assisted living”, “day care”, “hospital”, “residential care”, “public places”, “resident room”, “SCU”, “privacy”, “security”, “safety”, “behavioral changes” and “behavioral modifications”.

The titles, key words, abstracts and, where necessary, the methodology, discussions and/or conclusions of the papers identified by the electronic and manual searches were screened for potential relevance by one of the researchers. This was an over inclusive process designed to eliminate only papers that were obviously irrelevant, with 332 papers being identified as potentially relevant. The over inclusiveness was tested by both researchers assessing the first 39 papers available to both of them. They agreed that 32 of them were relevant. All seven of those for which there was disagreement were rated as relevant by the junior researcher, who was carrying out the screening, and judged as being not relevant by the senior researcher. There was no occasion when the screening researcher excluded an article that would have been included by the senior researcher. On completion of the screening by the junior researcher, 242 articles remained.

These articles were assessed for relevance by two researchers, resulting in the identification of 148 articles as relevant. Eight additional papers were identified during internal peer review process (see acknowledgment). Papers that were identified as relevant were then subjected to an assessment of their validity using the model provided by Forbes (1998).

The Forbes approach to the validation of the papers was chosen in the absence of any well-accepted alternative contender. The Forbes approach involves an assessment of external validity (design, inclusion, attrition), internal validity and statistical validity resulting in the allocation of a rating of strong, moderate, weak or poor. The most recent comprehensive review of the environmental design literature (Day *et al.*, 2000) did not attempt any systematic validation, while in the area of psychosocial research the Forbes approach has been used in recent reviews (Opie *et al.*, 1999; O'Connor, 2007). While the Forbes approach is not finely tuned to the methodologies used in the environmental design literature, an adaptation of it was used in the Cochrane Review on bright light therapy (Forbes *et al.*, 2004) and its use provides an opportunity for a future comparison between the strength of the environmental design literature and the psychosocial intervention literature.

In practice, the Forbes approach required a great deal of discussion between the two raters to come

to a consensus on the ratings and resulted in the description of some important work, particularly that of Namazi and Johnson (1991a; 1991b; 1992a; 1992b; 1992c; 1992d; 1992e) as weak or poor because of the descriptive nature of the statistical analysis and/or because of high attrition rates, which are sometimes impossible to avoid in research on very elderly people.

The methods used in 93 papers were judged to be "poor" as per the Forbes criteria (Forbes, 1998) and were excluded from the review. Additionally, two papers were excluded as we were unable to obtain sufficient details to apply Forbes criteria. This left 63 papers which were of sufficient quality (Forbes rating: 9 strong, 14 moderate, 40 weak but sufficient) and are included in the current review. The findings of these papers are reported below under headings based on Marshall's schema.

Results

A summary of the strong and moderately strong articles and their relationship to Marshall's schema is contained in Table 1.

Size of the care home

Perhaps the most influential combination of principles in recent decades has been that of "small and homelike". Their frequent combination makes it virtually impossible to tease out the individual contributions of the principles. While there is evidence supporting the proposition that small size – i.e. a small number of residents – is associated with a variety of positive outcomes for people with dementia (Annerstedt, 1993; Sloane *et al.*, 1998; Reimer *et al.*, 2004), it is impossible to quantify the contribution that the size of the unit makes in comparison with the other environmental factors that are commonly associated with a purposely designed, small unit, e.g. home likeness, safety and familiarity (Reimer *et al.*, 2004). The relationship between size and positive outcome is not always evident. No significant correlation was found between facility size – large or small – and physically aggressive behaviors in a sample of 695 residents of special care units (SCUs) and traditional nursing homes (Leon and Ory, 1999). However, this study defined large facilities as those with more than 150 beds, a definition that may have swamped the effects of genuinely small facilities. A recent study carried out in Holland found no relationship between neuropsychiatric symptoms and the number of residents per SCU or per living room in 25 nursing homes of regular size SCUs (Zuidema *et al.*, 2009). In smaller sized group living homes there was no difference in

behavioral problems compared to traditional, larger sized nursing homes (te Boekhorst *et al.*, 2009).

The relationship between behavioral disturbance and the size of the space in which the group lives has been investigated in two studies (Bowie and Mountain, 1997; Elmstahl *et al.*, 1997) and the findings suggest a lack of association between the amount of space available in a ward and the level of behavioral disturbance.

Optimum level of stimulation

People with dementia have difficulties in dealing with high levels of stimulation. Their ability to screen out unwanted stimuli appears to be reduced. They can become more confused, anxious and agitated when overstimulated (Cleary *et al.*, 1988). Common causes of overstimulation are busy entry doors that are visible to patients, clutter, public address systems (Cohen and Weisman, 1991; Brawley, 1997), alarms, loud televisions (Hall *et al.*, 1986; Evans, 1989), corridors and crowding (Nelson, 1995). The careful optimization of levels of stimulation is well supported (Cleary *et al.*, 1988; Cohen-Mansfield and Werner, 1995; Zeisel *et al.*, 2003). Methods of dealing with specific elements of the environment that cause overstimulation, e.g. hiding or disguising busy entry doors that provide a view to the outside, providing two wardrobes so that the resident accesses one that has only a manageable range of clothing in it, have been thoroughly investigated and found to be effective (Namazi *et al.*, 1989; Namazi and Johnson, 1992b; Dickinson *et al.*, 1995).

While it is necessary to reduce unhelpful stimulation, care must be taken to optimize helpful stimuli. There is good evidence that increasing levels of illumination beyond that which is usually considered to be normal can improve sleep patterns and reduce behavioral disturbance (Satlin *et al.*, 1992; Thorpe *et al.*, 2000; Ancoli-Israel *et al.*, 2003; Sloane *et al.*, 2007). The introduction of multi-sensory stimulation has been shown to improve mood and behavior as much as the introduction of an activity group (Baker *et al.*, 2001).

Studies involving the combination of reduced stimulation with other environmental and care practice manipulations have been shown to reduce behavioral disturbance (Bianchetti *et al.*, 1997; Bellelli *et al.*, 1998).

Residents in care homes are exposed to a variety of different noise sources including man-made noise and noise from household/electrical equipment. Repeated measurements in nursing homes in the U.S.A. revealed that noise levels reached 55–70dB, comparable to busy road traffic noise (Bharathan, 2007). One group videotaped

Table 1. Summary of strong and moderately strong papers

STUDY	METHODOLOGY	FORBE'S RATING	SAMPLE	STRONGEST RELEVANCE TO MARSHALL'S DESIGN FEATURES	INTERVENTION	OUTCOMES
Ancoli-Israel <i>et al.</i> (2003). "Increased light exposure consolidates sleep and strengthens circadian rhythms in severe Alzheimer's disease patients."	Randomized control trial with 3 treatment groups. Sleep patterns measured	Strong	92 patients nursing home residents with dementia	Control of stimuli	Morning bright light, evening bright light or morning dim red light.	Increasing light exposure throughout the day and evening is likely to have the most beneficial effect on sleep and on circadian rhythms in patients with dementia.
Baker <i>et al.</i> (2001). "A randomized controlled trial of the effects of multi-sensory stimulation (MSS) for people with dementia"	Randomised control trial	Strong	50 patients with diagnoses of moderate to severe dementia.	Control of stimuli	Multi-sensory stimulation compared with activity group.	Both interventions brought about improvements. MSS significantly better in increasing attentiveness to environment, mood and behavior.
Cohen-Mansfield and Werner (1995). "Environmental influences on agitation: an integrative summary of an observational study."	Time-sampling recording of behavior in various locations and conditions.	Strong	24 residents from three units. Unit 1 was an Alzheimer's unit and the other two units included a mixture of cognitively impaired and physically ill residents.	Control of stimuli	Physical environmental, social environment, activities and level of stimulation varied naturally during the course of the day and evening.	Increasing strange movements in the dark, pacing more frequently under normal lighting. Increasing agitation behaviors with high levels of noise, perceived cold, and being physically restrained.
Cohen-Mansfield and Werner (1998). "The effects of an enhanced environment on nursing home residents who pace."	Multiple single subject, pre test post test design with measures of agitation, mood and exit seeking.	Strong	27 nursing home residents who were rated as pacing /wandering at least several times a day.	Domestic and homelike	Visual, auditory, and olfactory stimuli were added to the nursing home corridors to simulate a home environment and an outdoor nature environment.	Residents spent more time in the enhanced environments and showed increased pleasure.
Phillips <i>et al.</i> (1997). "Effects of residence in Alzheimer disease special care units on functional outcomes."	One year longitudinal study with multiple measurements, using MDS, of locomotion, transferring, toileting, eating, dressing, ADLs, continence and weight.	Strong	Data on 841 nursing home residents in 4 states with 48 SCUs	Domestic and homelike	Life in a variety of residential aged care settings including SCUs.	No statistically significant difference was observed in the speed of decline for residents in SCUs and traditional units in cognitive and behavioral status.

Table 1. Continued.

STUDY	METHODOLOGY	FORBE'S RATING	SAMPLE	STRONGEST RELEVANCE TO MARSHALL'S DESIGN FEATURES	INTERVENTION	OUTCOMES
Reimer <i>et al.</i> (2004). "Special care facility compared with traditional environments for dementia care: a longitudinal study of quality of life."	A prospective, matched-group design with assessments of QoL every 3 months for 1 year	Strong	185 residents from 24 long-term care centers and 4 designated assisted living environments. 62 in the intervention SCU group and 123 in the traditional groups.	Small size, domestic and homelike, scope for ordinary activities	The provision of an environment that encompasses a vision of long-term care that is more comfortable, more like home, and offers more choice, meaningful activity, and privacy than traditional settings.	The SCU group demonstrated fewer declines in ADL, more sustained interest in the environment, and less negative affect. There were no differences between groups in concentration, memory, orientation, depression, or social withdrawal.
Sloane <i>et al.</i> (2007). "High-intensity environmental light in dementia: effect on sleep and activity."	A cluster-unit crossover intervention trial measuring night time sleep and day time activity	Strong	66 residents	Control of stimuli	Ambient bright light delivered through a low-glare lighting system installed in the dining and activity areas. Participant exposure averaged 2.5 to 3.0 hours for the morning and evening interventions and 8.4 hours for the all-day intervention.	Night-time sleep increased significantly in participants exposed to morning and all-day light. The overall strength of day and night activity rhythms did not change significantly under any treatment condition.
Wells and Jorm (1987). "Evaluation of a special nursing home unit for dementia sufferers: a randomised controlled comparison with community care."	Randomized control trial measuring cognitive status, behavior, QoL, psychological problems of caregivers pre-admission and at 3-month follow-up	Strong	12 people with dementia admitted to dementia specific facility, 10 in community care control group.	Domestic and homelike, safety features,, rooms for different functions, outside space, single rooms of an adequate size	Applicants for a newly opened special unit for dementia sufferers were randomly allocated to full-time care in the unit or placed on a waiting list and offered periodic respite care in the meantime.	Admission of dementia sufferers to full-time care in a special unit appears to be of great benefit to the psychological health of their care-givers and has no adverse effects on the dementia sufferers themselves.
Zeisel <i>et al.</i> (2003). "Environmental correlates to behavioral health outcomes in	Cross-sectional survey utilizing hierarchical linear modeling controlling for cognitive status, ADLs, medication	Strong	427 residents from 15 SCUs	Small size, domestic and homelike, rooms for different functions, single rooms of an	Life in various forms of SCU.	Privacy and personalization in bedrooms, residential character, understandable environment associated with reductions in aggression,

Alzheimer's special care units."	use, amount of Alzheimer's staff training, and staff-to-resident ratio. Measurement of aggression, agitation, social withdrawal, depression, and psychotic problems			adequate size, and control of stimuli		agitation and psychological problems. Camouflaged exit doors and rooms that vary in ambience associated with reduced depression, social withdrawal, misidentification and hallucinations.
Annerstedt (1993). "Development and consequences of group living in Sweden: a new mode of care for the demented elderly."	One-year follow-up of residents in a group living unit and a control group in traditional care. Measurements made of motor functioning, intellectual and emotional ability, symptoms of dementia, behavioral disturbance and ADLs.	Moderate	28 group living patients 31 patients living in traditional institutional care	Small size, domestic and homelike, and safety features	Homelike group living housing; supervision by trained registered nurses; staff training, and relatives' active role in the caring task	Group living environment produced better motor, emotional and intellectual functions, and less Psychotropic medication; less psychological strain among the relatives; improved competence and satisfaction among staff; and decreased the total cost of care
Bellelli <i>et al.</i> (1998). "Special care units for demented patients: a multicenter study."	Pre-admission, 3 month and 6 month post admission assessment of health status, medication and restraint use.	Moderate	55 patients with dementia transferred to 8 SCUs	Control of stimuli	Admission to SCU.	At 6-month follow-up, behavioral disturbances progressively improved despite the psychotropic drug load and physical restraints use decreased.
Bianchetti <i>et al.</i> (1997). "An Italian model of dementia special care unit: results of a pilot study."	Pre-admission, and 6-month post admission assessment of functional status, cognitive status, behavioral symptoms, medication and restraint use.	Moderate	16 patients transferred from traditional ward to a SCU.	Safety features, good signage and control of stimuli	Admission to SCU	Significant reduction in behavioral disturbances after relocation in SCU; no improvement in cognitive status or functional ability.
Bowie and Mountain (1997). "The relationship between patient behavior and environmental quality for the dementing."	Cross sectional survey comparing 5 environmental characteristics and patients' behavior in wards paired systematically to maximize differences in environmental characteristics.	Moderate	All patients with a dementing illness on 7 wards.	Small size and good signage	Life on wards with varying characteristics	Institutional character and lack of cues associated with behavioral abnormalities. Poor ward condition paradoxically associated with better self care and fewer behavioral problems. Small versus large physical size not associated with differences in behaviors.

Table 1. Continued.

STUDY	METHODOLOGY	FORBE'S RATING	SAMPLE	STRONGEST RELEVANCE TO MARSHALL'S DESIGN FEATURES	INTERVENTION	OUTCOMES
Cleary <i>et al.</i> (1988). "A reduced stimulation unit: effects on patients with Alzheimer's disease and related disorders."	Pretest / post-test measurements of functional ability, agitation, food consumption, continence, sleep, use of restraints, weight and medication use taken before and 3 months after admission.	Moderate	11 low stimulus unit residents with dementia.	Control of stimuli	Admission to low stimulus unit.	Reducing patients weight loss, agitation, physical restraint use. Increased relatives' satisfaction.
Cox <i>et al.</i> (2004). "Multisensory environments for leisure: promoting well-being in nursing home residents with dementia."	Cross-over (within subjects) design with measurement of affect under 3 conditions.	Moderate	24 residents with dementia	Outside space and control of stimuli	Residents experienced three activities (living room, garden, Snoezelen room) during three individual 16-minute sessions.	Some evidence of increased pleasure in the Snoezelen room and garden.
Dickinson <i>et al.</i> (1995). "The effects of visual barriers on exiting behavior in a dementia care unit."	Pre-test / post-test measuring exit attempts	Moderate	7 residents with dementia and history of exiting attempts.	Control of stimuli	Installation of a blind and cloth cover panel over panic bar on door.	Visual barriers serving to camouflage the panic bar or door knob are effective and cost-efficient controls for wanderers' exiting.
Hewawasam (1996). "The use of two-dimensional grid patterns to limit hazardous ambulation in elderly patients with Alzheimer's disease."	Pre-test / post-test measuring exit attempts.	Moderate	10 patients with dementia	Good signage	Black insulation tapes in two different grid configurations were laid out in an attempt to prevent patients ambulating through exit doors.	The use of a horizontal grid reduced exit door contact up to 97% for four of these patients.
Leon and Ory (1999). "Effectiveness of Special Care Unit (SCU) placements in reducing physically aggressive behaviors in recently admitted dementia nursing home residents."	Stratified cluster samples entering SCUs and traditional nursing homes compared on levels of agitation over the 6 months post admission.	Moderate	695 residents; 495 entered SCUs and 200 were admitted to non-SCU facilities.	Small size	Admission to SCU.	SCU placement showed no positive or negative effect on the frequency of aggressive behaviors. A reduction in physical aggression attributed to increased use of psychotropic medications and the reduction in the use of physical restraints.

Mayer and Darby (1991). "Does a mirror deter wandering in demented older people?"	Pre-test post-test measurement of exiting behavior.	Moderate	9 severely demented residents	Good signage	3 experimental conditions: a full-length mirror placed in front of the door, the mirror reversed and no mirror.	The presence of mirror in front of an exit cues the response not to touch, reducing exit attempts by 50%.
Melin and Gotestam (1981). "The effects of rearranging ward routines on communication and eating behaviors of psychogeriatric patients."	Pre-test / post-test measurement of communication and eating behaviors in control and experimental groups.	Moderate	21 patients on a psychogeriatric ward	Scope for ordinary activities	Introduction of eating at tables rather than from trays attached to chairs set around the walls.	The frequency of communication increased in the experimental group.
Morgan and Stewart (1998). "Multiple occupancy versus private rooms on dementia care units."	Pre-test / post-test measurement of time spent in various locations plus qualitative observations from staff and family.	Moderate	46 SCU residents 9 staff caregivers and 9 family members	Single rooms of an adequate size	Residents moved from 2-bed or 4-bed rooms to private rooms in SCUs.	Following the move to the new SCUs with private bedrooms, residents spent more time in their rooms during the day and required fewer interventions (including medications) to promote sleep at night. Perceptions of staff and family members about person-environment interaction model were positive.
Satlin, <i>et al.</i> (1992). "Bright light treatment of behavioral and sleep disturbances in patients with Alzheimer's disease."	Pre-test/post-test measurement of agitation, sleep patterns, restraint use and PRN medications.	Moderate	10 residents with sundowning behavior and sleep disturbances.	Control of stimuli	Patients received 2 hours/day of exposure to bright light for 1 week.	Clinical ratings of sleep-wakefulness on the evening nursing shift improved with light treatment in 8 patients. The relative amplitude of the circadian locomotor activity rhythm increased.
Thorpe <i>et al.</i> (2000). "Bright light therapy for demented nursing home patients with behavioral disturbance."	Repeated measures of ABA design, measuring agitation and disruptive behaviors.	Moderate	16 residents with dementia	Control of stimuli	Bright light (2,000 lux) administered for 30 minutes during breakfast.	Bright light therapy has modest efficacy in reducing agitation, with possible concurrent improvement in positive behaviors.

ADL = activities of daily living; MDS = minimum data set; MSS = multi-sensory stimulation; QoL = quality of life; SCU = special care unit.

nursing home residents to identify antecedents of agitated behavior and it appeared that unwanted music or interruption to pleasurable music can lead to agitated behavior (Ragneskog, 1998). Noise has been recognized as a possible contributing factor to poor sleep. However, interventions in nursing homes to reduce night-time noise have not improved sleep time (Ouslander, 2006), although another study using non-pharmacological interventions, including decreasing noise levels to increase night time sleep, found a modest benefit (Alessi, 2005). Furthermore, Alessi *et al.* (1999) established that a combination of increased physical activity during the day and reduced noise levels at night can lessen agitation in nursing home residents.

Total visual access

The observation that people with dementia stand a better chance of finding something if they can see it from where they are led to the idea of "total visual access," which was incorporated into the design of the NSW Health units for the confused and disturbed elderly (CADE) (Fleming and Bowles, 1987). It resulted in a very simple, corridor-free environment. The evidence for the incorporation of good visual access on the unit-level scale is not strong (Elmstahl *et al.*, 1997; Passini *et al.*, 2000) but the dramatic effect of making an important amenity – the toilet – easily seen provides good supporting evidence for the concept (Namazi and Johnson, 1991a).

Unobtrusive safety features

The level of safety and security in facilities designated as providing care to people with dementia is higher than in other facilities (Morgan *et al.*, 2004). One of the most common problems associated with caring for people with dementia in an environment that has not been designed for their use is that of keeping them safe from the danger of wandering away and perhaps getting lost or run over (Rosewarne *et al.*, 1997). The most obvious response to this problem is to provide a secure perimeter, preferably one that allows for safe wandering and access to an outside area.

Positive effects have been found when unobtrusive means are used to provide a secure perimeter (Zeisel *et al.*, 2003). Depression was negatively correlated with exits that were well camouflaged and had silent electronic locks rather than alarms. Zeisel hypothesized that residents would try to leave less frequently in such settings and that caregivers, believing that such environments are safer, would give residents greater independence of

movement. Residents who experience this greater freedom have less conflict about trying to leave and feel a greater sense of control and empowerment, leading in turn to less depression (Zeisel *et al.*, 2003).

Placing a horizontal grid of black tape in front of an exit reduced contact with the door by up to 97% in four people with Alzheimer's disease (Hewawasam, 1996). The presence of a mirror in front of an exit was found to cue the response not to touch, reducing exit attempts by 50% (Mayer and Darby, 1991), and hiding the latch behind a cloth panel reduced the number of attempts to exit (Dickinson *et al.*, 1995; Dickinson and McLain-Kark, 1998).

The beneficial effects of unobtrusive safety features, particularly in relieving depression, were noted in an early randomized controlled trial (Wells and Jorm, 1987; Zeisel *et al.*, 2003). The need for security to be unobtrusive and to avoid restraining people with dementia who, while confused, are not likely to abscond is supported by the finding that harmful behaviors, particularly risk taking and passive self harm, were associated with more security features (Low *et al.*, 2004). The possibility that an emphasis on safety reduces enjoyment of activities and the feeling of being able to control the environment has been suggested in a U.K. study (Torrington, 2006).

Availability of rooms to suit varying functions or specific purpose

The provision of rooms for different functions has been shown to differentiate SCUs from non-SCUs in a statewide survey involving 436 nursing homes in Minnesota (Grant *et al.*, 1995). The strongest evidence for its importance comes from the well controlled study by Zeisel *et al.* (2003) that provides some certainty about the contribution of the individual factors to the well-being of the residents. It concluded that the degree of privacy-personalization in the SCUs studied was negatively correlated with patient scores on the Cohen-Mansfield total aggression scale. Residents in facilities with more individual rooms and more opportunities for personalization tend to experience less anxiety and aggression. The provision of common areas that vary in ambience is associated with reduced depression, social withdrawal, misidentification and hallucinations.

A well conducted cross-sectional study involving 38 homes and 452 residents (Barnes, 2006) showed that gradation of space is associated with resident quality of life, highlighting the necessity for design guidance to emphasize a variety of spaces.

The availability of private rooms has been shown to reduce irritability and improve sleeping patterns in people with advanced Alzheimer's disease and other related disorders (Morgan and Stewart, 1998).

Social environment (homeliness, activities and outside space)

The problem of an intricate relationship between the social/professional environment (the philosophy of care, staff skills, good management practices) and the physical environment appears again when assessing the impact of providing a homelike environment, especially in the case of people with advanced dementia. However, there is good evidence that such an environment reduces aggression (Zeisel *et al.*, 2003). A very well controlled investigation of the effects of introducing a few of the most basic elements of a homelike environment into a very institutional nursing home (Cohen-Mansfield and Werner, 1998) showed that residents chose to spend time in a corridor containing comfortable chairs, pictures, coffee table, books and the aroma of citrus in comparison with a normal corridor. There was a weak trend to reduced agitation, pacing and exit seeking in comparison to behavior in a normal corridor but this positive trend was stronger when, instead of a domestic setting being provided, a setting reminiscent of a natural outdoor setting was provided. The differences between the two enhanced settings were small.

If it can be assumed that homelikeness is a feature of SCUs in the U.S.A. – and there is some doubt about this (Chappel and Reid, 2000) – then the findings of the four State study of 800 facilities (Phillips, 1997) are relevant. This study showed that SCU residents declined at the same rate as non-SCU residents matched for baseline cognitive status, behavioral problems, age, sex and length of stay.

The provision of opportunities to engage with ordinary activities of daily living is often associated with the principle of homelikeness (Verbeek *et al.*, 2009). There is moderately strong evidence for the beneficial effects of providing people with dementia with an environment that gives them this opportunity (Melin and Gotestam, 1981.; Reimer *et al.*, 2004). However, it is very difficult to differentiate the contribution of the physical environment from that of staff encouragement and support.

Similarly, there is little evidence for the benefits of outside spaces by themselves but good evidence of benefit when combined with staff interaction (Cox *et al.*, 2004).

Signage and orientation cues

Perhaps surprisingly, the evidence for the beneficial effects of signage is not strong (Hanley, 1981; Namazi and Johnson, 1991b) and weak empirical support was found for the use of the display of personal memorabilia as aids to orientation (Namazi *et al.*, 1991).

Discussion and conclusions

Marshall's schema provides a useful framework for organizing the existing literature. The items in it are broad but sufficiently detailed to inform a literature search and to help identify areas of strength and weakness in our knowledge base. The available research suggests that designers and architects may be confident about using unobtrusive safety measures; varying the ambience, size and shape of spaces; providing single rooms; maximizing visual access to important features and providing for stimulus control with the periodic availability of high levels of illumination.

There is less agreement on the usefulness of signage of various sorts and the quality of the research is sufficiently high to suggest that we should not be placing much emphasis on this area. The response to the identification of other areas where there is limited empirical support – e.g. homelikeness, provision for engagement in ordinary activities of daily living, small size, provision of outside space – should perhaps be different. These are areas where there is a great deal of anecdotal and experiential evidence to suggest that they are highly desirable. They are worthy of more research before concluding that they are unimportant and the research must be designed to control for the confounding effects of changes in staff attitudes and skills.

Most of the research has been carried out in special care units, a generic term that covers a wide range of facilities, but tends to focus on the relatively physically robust person with dementia. There is little research on the impact of dementia on people in the final stages of the disease where physical frailty is very common. It is therefore clear that we are not in a position to provide a formula for the design of an environment that will suit the needs of everyone. The evidence does not exist to support the description of a well-designed environment for the person with dementia who is in the final stages of palliative care and, perhaps more importantly, there is a consensus that while common elements may be identified there cannot be one optimal environment. The environment should, as far as possible, meet the individual needs of the resident, and as these will

vary even within a single facility, every environment will be a compromise.

Designing for dementia in isolation from other common problems encountered by the elderly, e.g. sensory deficits and falls, is far from ideal but the evidence base for designing for combinations of problems is very small indeed. There is also the issue of designing for the person caring for the person with dementia, both the professional carer and the relatives who visit. How can the needs of these people be met by the physical environment?

It may yet be too early to argue for the provision of definitive guidelines for the design of long-term care units for people with dementia. While progress has been made since 1980 the evidence base is still not strong. Yet there are some aspects of design that promote confidence and the need to offer guidance in this large and expanding area of service provision is great. The following suggestions are offered as a contribution to the process of determining guidelines. Perhaps the next step in this process should be a consensus statement. The suggestions are offered as an update on those that have already been offered (Day *et al.*, 2000; Marshall, 2001).

The empirical evidence supports the advice that long-term facilities for people with dementia should be designed and constructed with these features in mind:

1. Where it is necessary to provide for the safety and security of the residents by confining them within a secure perimeter, this should be achieved by means of unobtrusive security measures that maximize the feeling of control over the environment.
2. Those parts of the facility which are accessible to the residents should contain a variety of spaces that provide the residents with differing ambience, size and function.
3. Each resident should have the opportunity to have a single room and be allowed to personalize that room.
4. Residents should be able to see the features that are most important to them from the location(s) where they spend most of their time.
5. The levels of stimulation should be adjusted to minimize unhelpful stimulation and optimize helpful stimuli with the periodic availability of high levels of illumination.

Furthermore, it is desirable that the facility should:

6. be small
7. have a homelike appearance
8. provide opportunities for engagement with the ordinary activities of daily living, and
9. have an outside space that is accessible to the resident when accompanied by a member of staff.

Conflict of interest

None.

Description of authors' roles

R. Fleming designed the literature review, supervised and contributed to the review of the articles and wrote the paper. N. Purandare supplemented the review with additional articles on noise levels in long term care and contributed to the style and content of the article.

Acknowledgments

Professor Henry Brodaty, Director of the Primary Dementia Collaborative Research Centre based in the University of New South Wales, Sydney, Australia provided valuable comments during the peer review process. Dr. Sytse Zuidema, Department of Primary and Community Care, Centre for Family Medicine, Geriatric Care and Public Health, Radboud University Nijmegen, Medical Centre, Nijmegen, Holland provided valuable comments and additional papers for review during the peer review process. Dr. Shima Sum, Paramedicine Faculty, Babol University of Medical Sciences, Babol, Mazandaran, Iran provided invaluable assistance with sourcing and reviewing the articles in the literature review used as the basis for this paper.

The writing of the literature review used as the basis for this paper was supported by a grant from the Primary Dementia Collaborative Research Centre, University of NSW, as part of the Australian Government's national initiative "Dementia: A Health Priority".

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